

ICZM TECHNOLOGIES FOR INTEGRATING DATA AND SUPPORT DECISION MAKING

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I. INTRODUCTION

This paper aims to identify strategies for Integrated Coastal Zone Management (ICZM), coastal planning and sustainable development in north Adriatic using spatial modelling based on Geographic Information System (GIS). Geographic Information System (GIS) are valuable instruments to coastal managers in data integration and in identifying coastal impacts and conflicts, conservation "hot spots". GIS allows experimentation with various management approaches to working with coastal space planning and resources management (Vallega, 2005). Decision support systems (DSS), ecosystem modelling, and resource assessment allow users to put GIS data bases to their full use for individualized applications or research studies. GIS and GIS Based DSS are recognized widely as a valuable tool for managing, analyzing, and displaying large volumes of diverse data pertinent to coastal planning activities (at both local and regional scales). Its use in coastal management and planning is rapidly increasing. In European coasts, Industrial development, urban and infrastructure sprawl, fishing, gas extraction and tourism are activity conflicting and with high impact on environmental system. Hence, the strength of sustainable planning can be enhanced by GIS applications.

II. MATERIALS AND METHODS

The study analyzed 3 study areas in North Adriatic Italian coast: Venice, Rimini and Conero. Lagoon of Venice is characterized by an extraordinary mixing of activities: tourism, fishing, industrial areas (petrochemical plants). Rimini area is one of the most important beach tourist areas in Mediterranean Sea. Conero Area is in the Ancona Province, with an important industrial port and a petrochemical plant (API, Falconara). In spite of this, Conero is a wild mountain with a cliff coast; it is a park and Marine Protected Area with important ecosystems and geosites.

The process of ICZM can be described by an integrated set of indices, at a geo-ecological level, modelling earth processes, human society and economy, and coastal uses at multiple scales (Vallega, 1999). The study describes a methodological approaches based on the integrated use of Geographic Information System (GIS) and Multi Criteria Decision Model (MCDM) to identify nature conservation and development priorities among the coastal areas. A geographic information system (GIS), and a geographic resources analysis support system (IDRISI™, Andes version) were used. IDRISI™ was used for the analysis of coastal changes and multi criteria analysis (MCA) (Eastman, 2006). A set of criteria were defined to evaluate coastal ecological status. Those criteria are space based following the landscape ecology methods and framework. Landscape ecology investigates the effect of the spatial arrangement of patches and corridors and related processes into a geographic area (Forman and Godron, 1986). Important applications to coastal management are the definition of Homogeneous Environmental Management Units (Brenner et al., 2006), the analysis of spatial and temporal structure, hierarchy and dynamics over multiple scales (Naveh and Lieberman, 1994; Marotta, 2006), the assessment of cumulative impacts and habitat loss in coastal ecotones (Thrush et al., 2008). GIS integrate and uses different data. For the landscape analysis and individuation, two Landsat satellite scenes were used for each study area.

The used indices and indicators for sustainability/health metrics were: Emergy, defined as all the available energy that was used in the work of making a product and expressed in units of energy (Odum, 1996); Exergy of a system, as the maximum work possible during a process that brings the system into equilibrium with a heat reservoir. When the surroundings are the reservoir, exergy is the potential of a system to cause a change as it achieves equilibrium with its environment. Exergy is then the energy that is available to be used. After the system and surroundings reach equilibrium, the exergy is zero (Jørgensen, 2006). Using land-use data and development-intensity measures derived from energy use per unit area, an index of landscape development intensity (LDI) can be calculated for the coastal zones to estimate the potential impacts from human-dominated activities.

The intended use of the LDI is as an index of the human disturbance gradient (Brown and Vivas, 2005). The ecosystem function is measured using the biological capacity potential (BTC, Ingegnoli and Pignatti, 2007), based on resistance stability, vegetation type, and metabolic data of vegetation. Ecosystem services are based on the values calculated by Costanza et al. (1997).

III. RESULTS

The value of indices and indicators are linked to the land/sea use. The resulting values of indices are calculated in the coastal fringe. The Sustainability weak and strong and the minimization are the used criteria. Having defined the criteria, the next step was selecting suitable indicators to measure the selected criteria. Subsequently the criteria were evaluated from industrial development, conservation and tourism development point of view. These criteria were then ranked MCA and the results integrated into GIS. Several conservation scenarios are generated so as to simulate different evaluation perspectives. The scenarios are then compared to highlight the most feasible and to propose a conservation and development strategy for the coastal area. The generation and comparison of conservation and development scenarios highlighted the critical issues of the decision problem, i.e. the dunal and wetland ecosystems whose conservation and development relevance is most sensitive to changes in the evaluation perspective. Results shows the increasing during time of impacts and the need of governance of conflicts, unsustainability in resources use, urban and infrastructures sprawl, and pollution phenomena. Planning and management based on indices benefit from landscape ecology principles. For ICZM to advance and to make legitimate contributions to coastal sustainability, it must be practiced in a transdisciplinary manner – for it must meet the system knowledge, the needs of stakeholders, benefit from the support of decision makers, engage scientists and engineers and challenge planners and designers to innovate. The proof of its success depends on the extent to which real management follow-up programs, monitoring and systematic evaluations of long and short term results are made. This study represents an important contribution to effective decision-making because it allows practical results for both resource consumption and spatial planning.

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